

WEB APPLICATION TO TEACH ELEMENTARY SCHOOL STUDENTS SENTENCE PARTS VIA DIAGRAMMING

Carl Geary Scherer, Jr.
Georgia Institute of Technology
Masters of Science in Computer Science,
term paper for CS6460, Educational Technology
geary.scherer@gatech.edu

ABSTRACT

While many educators avoid the subject of diagramming sentences when teaching English sentence parts and grammar, this paper presents a web application that leverages simplified sentence diagramming to teach or reinforce existing knowledge of sentence parts in elementary school students. It uses a visual depiction of sentences that has several levels of complexity to appeal to varying age students and provides feedback that mimics an Intelligent Tutoring System to help students complete their learning goals.

KEYWORDS

Mobile Learning, Intelligent Tutoring Systems, English Grammar.

1. INTRODUCTION

This paper details a mobile application for students of elementary schools that teaches diagramming of English sentences in order to facilitate learning and retention of the parts of English sentences. The target platform is mobile devices, specifically Android tablets. Apple iOS based devices (iPads, iPhones, iPod Touch) are specifically not supported.

Elementary school students sometimes struggle with remembering the parts of English sentences and in recognizing the parts accurately in a sentence. Some students would benefit from learning sentence parts in a visual method. Research shows students either are more skilled at or simply prefer to learn in visual, aural, or kinesthetic learning modalities. Many students benefit from multimodal methods, in other words from more than one method of learning but grammar education typically focuses on aural and very limited visual learning. The visual aspect being limited to reading words which does not provide visual learners enough visual information to help their memory and learning process.

The idea of visual, aural, and kinesthetic learning modalities comes from (Dunn and Dunn, 1978) and (Barbe et al, 1979). They argue that different learners process and thus learn new information and encode knowledge differently based on the learner's individual strengths or preferences across the 3 learning modes. (Fleming, 1995) argues in more recent research that there is a fourth modality he calls the reader/writer. In the example of a student taking notes during a lecture, the reader/writer type learning is able to take exacting notes and remember the vast majority of what was presented by taking notes. The visual learner tends to focus on the diagrams and the aural preference learner tends to focus on the way the lecture is delivered in speech but may get lost on the higher principles being described (Bloom, 1984). The main thing to take away from the information the researchers presented was that lots of students are able to learn in several modes and that while Fleming argues that some students are void, meaning relatively weak, at learning in particular mode, many are strong in more than one modality. When looking at Fleming's model, in a traditional English grammar classroom in a primary school, aural learners get to hear a teacher give a lecture and reader/writers get to take notes about the grammar rules. Visual learners who prefer visuals in place of exclusively text heavy presentation are at a disadvantage. But for kinesthetic learners, the gap is

even bigger. They may prefer to be able to touch the concepts they are learning while seeing them and interacting with the ideas in a more tangible way.

2. APPLICATION HIGH LEVEL FEATURES

2.1 Matching Learning Modality

The *Sentence Diagrammer* application meets the need for both visual and kinesthetic learning of sentence structures and parts. The graphing inherently present in sentence diagrams will help visual learners break down sentences into component parts in a way they can process and learn more easily. For kinesthetic learners, being able to diagram by touching the parts of the sentence and moving them around will provide an experience better suited to their learning tastes. The tablet experience provides some degree of touch interaction that benefits those learners.

2.2 Experiential Learning

Another positive of the app's learning strategy is it is more experiential than rote memorization. Kolb wrote about how experience and reflection combine to make a more productive learning process (Kolbe, 1984). I have not yet come up with a way of using reflection in the learning process for the proposed app but the process of diagramming will take advantage of the other 3 phases of ideal learning Kolb described.

Table 1. The three Kolbe phases reflected in the application

Phase	How Implemented in App
Concrete Experience	in learning to diagram by doing
Abstract Conceptualization	in internalizing the ideas presented and used
Active Experimentation	in applying the ideas to new sentences

2.3 Why Mobile Learning

The research suggests that using mobile apps to add to the learning experience can have a significant positive effect on students' results. Ling et al showed that statistics learning was measurably improved by using an app to enhance learning (Ling et al, 2014). They showed an improvement from 58% correct answers on a quiz for the control group to 74% correct for the app users.

2.4 Intelligent Tutoring Systems

The way the app will interact with users is by providing hints and guidance when the user makes mistakes. This type of interaction is typically termed an Intelligent Tutoring System (ITS).

An ITS typically tries to simulate the interaction between a student and a one-on-one human tutor. The reason for trying to do this is that there is clear evidence that an average student (scoring in the middle 50% on performance evaluations for a topic) commonly can improve two full standard deviations (Bloom, 1984), 2σ or from 50% to 98%, on performance scores within the tutored topic if provided good, one-on-one tutoring with a human instructor. Computerized tutoring systems have been found to do a fair job if well implemented, often helping tutored students do 1.05σ better (or taking someone scoring 50% up to scoring about 85%).

ITS have several examples of research that has been done and tools that have been developed for subjects that are science or math based (Steenbergen-Hu, 2013) as well as subjects like reading, writing, economics, and methods of research. We were unable, however, to find much about using an ITS to help with elementary school aged students learning English grammar. We are specifically interested in students

learning about sentence structure and parts which we approximate to around 2nd through 4th grade in the southeastern US educational system.

2.5 Sentence Diagramming Context

The author's educational background is having attended Catholic schools and in about 4th through 6th grade, having had to learn the art of sentence diagramming, largely based on the Reed-Kellogg method (Reed and Kellogg, 1881). There now seems to be nearly a consensus among educators that sentence diagramming is not the best way to learn grammar. The explanations typically state that languages are learned by use and not by structured building of systematic rules (Cleary, 2014). It is our contention, however, that structured analysis of a sentence does serve some useful purposes for learning English grammar for some students. The visual drawing of the parts of the sentence help learners who are more visually inclined because it helps them to see a sentence as parts that fit together and are connected to each other in a clearly understandable way. An anecdotal example of the problem is the author's experience with 4th graders who are being asked to identify prepositions in sentences. Some try to rely on memorizing a list of prepositions and thus often miss words they forgot from the list. Our theory is that being able to diagram a sentence's parts would make it much easier for some students to learn to find a particular sentence part by breaking down all the parts visually.

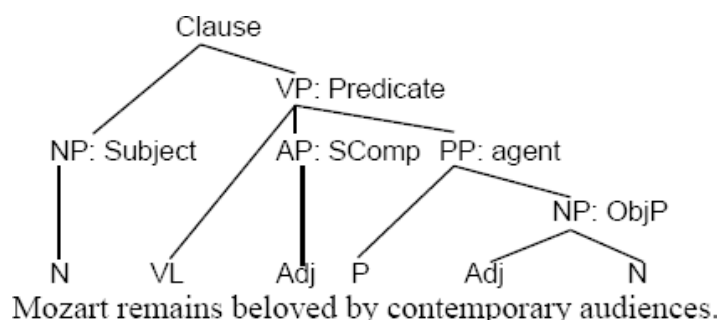
2.6 Available Applications

In looking for existing research, we found a few examples of mobile apps that try to teach grammar. Many apps that teach English grammar do so from an English for Students of Other Languages (ESOL) perspective. That leads to focusing on teaching sentences as opposed to the parts of the sentences and so it is not particularly useful for young, native English speakers. We did find a decent app, called *interactive English Grammar 10* (UCL Business PLC, 2013), that does help students practice recognizing word types in sentences but we did not find it to be very helpful at teaching how to recognize the parts correctly.

2.7 Which Diagramming Style to Use

The Reed-Kellogg method is very demonstrative for showing how certain phrases group together but modify another word or group (such as a prepositional phrase modifying an adjective or verb phrase). The demonstrative nature of the method also makes it more complex to learn because there are different symbols (slanted lines, dashed lines, straight lines, etc.) that have specific meanings and sometimes change meanings when combined with other symbols. A simpler and often superior way of diagramming sentences is the tree method (Navigating English Grammar, unknown date) which is shown in the diagram below. This is the diagramming method the *Sentence Diagrammer* application uses.

Figure 1. An example sentence diagram, from Navigating English Grammar, using the tree method



3. APPLICATION DETAILS

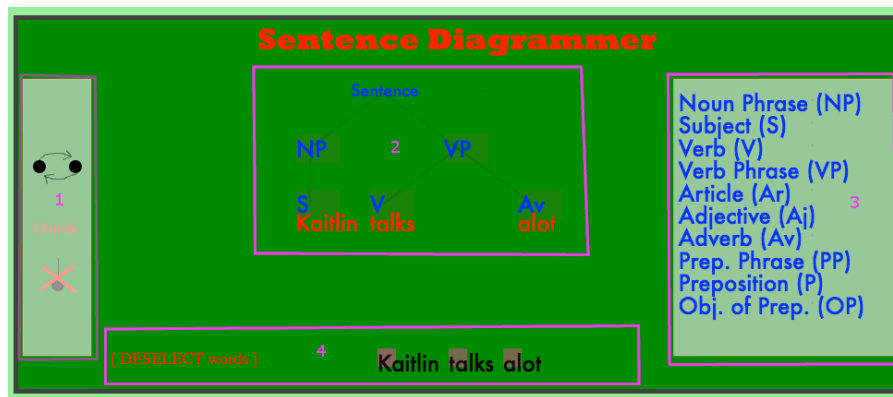
3.1 Technical Parts

Table 2. Technical details of the application

- **HTML5 Canvas** is used for the entire application screen where the diagrams are created.
- **Javascript** and **CSS** are used in close coordination with the **HTML5 Canvas** code.
- The core **HTML5 Canvas** code utilizes a code library from a book (van der Spuy, 2015).
- **PHP** is used for interfacing with database tables and checking results against those tables.
- The database used to store the sentences and the solutions is **MySQL**.
- The target platform is **Android-based** tablets.
- Desktop/laptop PCs (Windows or Mac OS) are supported under Chrome or Firefox browsers. Safari under Mac OS is not supported and Internet Explorer (or Edge) under Windows was not tested but is unlikely to work fully.
- Apple iOS devices are specifically not supported.

3.2 UI Layout

Figure 1. The four screen areas of the application. This image is from a previous revision



The *Sentence Diagrammer* application main screen has four sections. The right most section, labeled (3) in Figure 1, is where a user selects a part of the sentence to add to the diagram. When adding a part of speech that is a leaf on the diagram, users first select the sentence part from area (3) and then select the word from the sentence in area (4). When adding a node, after selecting a part of the sentence and a word from the sentence if appropriate, the user selects the spot on the graph to add the new node. Nodes can only be added to leaves of the tree and the word ‘Sentence’ marks the root of the tree. A more complete tutorial of using the application is available at <https://youtu.be/EvHOCuoHao>.

3.3 Known Issues

Table 3. Known issues with the application

- Deleting leaves from the tree breaks the diagram view in some cases. Deleting from right to left works ok but deleting from the middle or left side of the diagram sometimes makes the diagram look either shifted left or collapsed about the middle. The workaround is to hit the browser refresh when a mistake is made or to delete all nodes from right to left until the mistake is removed.
- The app does not immediately support users moving up (or down) between levels. The app infers the user’s level by how close to correct they are. A more game like flow with users advancing in levels could be added relatively easily.
- Complex sentences can have more than one correct diagram due to differing ways to interpret sentences (the ambiguous modifier problem). The example sentences were chosen to mitigate this issue but a deeper library

of complex sentences would potentially need more than one correct solution accepted or it would need to help the user understand what the 'preferred' solution is and why.

- The list of parts of a sentence to choose from is not complete. For example, an Indirect Object is not currently included. The application could mitigate this issue by change the available parts of a sentence to choose from based on what the sentence contains but always showing a complete list is probably infeasible in the current layout.
- No user logins are currently used so there is no tracking of user learning progress. This would be very easy to add.

4. CONCLUSION

The goal is not to replace current grammar teaching methods with this app but to use it as tool to help learners struggling with recognizing sentence parts correctly who also find the constructing and deconstructing nature of the app design appealing. As the user starts creating diagrams, the ITS reacts to successes and mistakes to provide ongoing feedback to the user to encourage and guide them in the process of diagramming sentences and thus identifying constituent sentence parts. Using sentence diagramming as a tool to help elementary students visualize sentence parts clearly has the potential to facilitate English grammar learning. Using mobile devices as the platform for such learning can make the subject more approachable for young learners. For future work, the application would need to be glossed up somewhat to appeal to young students who in this era have a high familiarity with native mobile applications and mobile centric websites and web apps. Adding drag and drop features (which both HTML5 and the library used for this app support) might be one way to make the interface more tactile and engaging.

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